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4 **Towards an integrated understanding of greenspace in the built environment**

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Towards an integrated understanding of green space in the built environment

Abstract

In recent years social, economic and environmental considerations have led to a re-evaluation of the factors that contribute to sustainable urban environments. Increasingly, urban green space is seen as an integral part of cities providing a range of services to both the people and wildlife living in urban areas. With this recognition and resulting from the simultaneous provision of different services there is a real need to identify a research framework in which to develop multidisciplinary and interdisciplinary research on urban green space. In order to address these needs an iterative process based on the Delphi technique was developed which comprised email-mediated discussions and a two day symposium involving experts from various disciplines. The two outputs of this iterative process were (i) an integrated framework for multidisciplinary and interdisciplinary research, and (ii) a catalogue of key research questions in urban green space research. The integrated framework presented here includes relevant research areas (i.e. ecosystem services, drivers of change, pressures on urban green space, human processes and goals of provision of urban green space) and emergent research themes in urban green space studies (i.e. physicality, experience, valuation, management and governance). Collectively these two outputs have the potential to establish an international research agenda for urban green space, which can contribute to the better understanding of people's relationship with cities.

Key words: Delphi technique, multidisciplinary studies, interdisciplinary studies, research agenda, urban ecology, urban green space.

Introduction

A number of significant factors which are converging and forcing a re-examination of the way cities are planned, designed and lived in. The *Global Environment Outlook* (UNEP, 2007) identified five drivers for human development: demographics; economic processes (consumption, production, markets and trade); scientific and technological innovation; distribution pattern processes (inter- and intra-generational); and cultural, social, political and institutional processes (including human behaviours and the production and service sectors). These drivers, and others that may emerge, will have substantial consequences for urban development, and hence green space within urban areas, yet there is great uncertainty about the ways in which urban areas will be affected. What is lacking is a framework for multidisciplinary research that would form an evidence base to support these changes and actions.

The terms green space and open space are often used interchangeably (Swanwick et al., 2003). In order to address the confusion that may occur they defined the key terms more clearly. Swanwick et al. (2003, pp97-98) suggested that urban areas are made up of the built environment and the external environment between buildings. The external environment, in their model, is composed of two distinct spaces: “grey space” and “green space”. Grey space is land that consists of predominantly sealed, impermeable, ‘hard’ surfaces such as concrete or tarmac. Green space land, whether publicly or privately owned, that consists of predominantly unsealed, permeable,

‘soft’ surfaces such as soil, grass, shrubs, trees and water. In this paper the authors follow this definition of green space whilst at the same time recognising that the juxtaposition of green and grey spaces is essential in towns and cities.

Across Europe development trajectories of towns and cities vary (Kasanko et al., 2006). Where the populations are falling (so-called ‘shrinking cities’; Mace et al., 2007) there are opportunities exist to redesign the built and external environments in order to improve liveability and sustainability. Where populations are growing and cities are expanding spatially (urban sprawl), or confined by physical or policy boundaries (e.g. green belts), there is a decrease in per capita space and often a need to address issues of urban green space loss.

Whilst an understanding of the multiple functions of urban green spaces is reasonably well developed it is not well integrated into the planning, design and management process (Yli-Pelkonen and Niemelä, 2005; Sandström et al., 2006). Furthermore, reliable and robust approaches to the valuation of urban green space that effectively support decision making are often absent (Tyrväinen, 2001; Neilan, 2008). Therefore, it is desirable to develop evidence on which to base decisions, to identify the key issues requiring research, and to present these in a way that is accessible to academics, practitioners and decision makers.

This paper reports on the outcomes of a symposium held at the University of Salford, UK during June 2007. This symposium was developed in recognition of three important gaps in urban green space research: the need to encourage interdisciplinary and multidisciplinary approaches, the need to develop joint, multidisciplinary

132 initiatives across Europe, and the need for comparative research. Experts from
133 different disciplines, countries and job roles (e.g. academics, practitioners and
134 decision makers) attended the symposium with the goal to develop, and subsequently
135 agree on, an integrating framework that would bring together different discipline and
136 professional interests in urban green space. Emergent from this process was a
137 catalogue of key research questions for urban green space research and the synthesis
138 of these into an integrating framework to support multidisciplinary and
139 interdisciplinary understanding and communication, decision making, and research
140 efforts. In this paper the authors propose an international research agenda relating to
141 this key component of urban living.

142
143 The paper is primarily informed by research in the European and North American
144 context and by European issues and practices. It is intended that the agenda will
145 influence regional, national and international research funding allocations and inform
146 the discussion of those concerned with identifying the needs and priorities of urban
147 green space.

148 149 **Process**

150
151 The need for a multidisciplinary approach in urban green space research was
152 identified during discussions held amongst the participants at the European Society
153 for Conservation Biology meeting in Eger, Hungary. Subsequently, the overall
154 process was based around a modified Delphi Technique, a widely used technique in
155 consultation exercises where consensus is required (Ndour et al., 1992; Medsker et al.,
156 1995; Curtis, 2004; Okoli and Pawlowski, 2004).

157

158 The modified Delphi Technique was divided into three stages, an initial stage where a
159 group of forty individuals were invited to partake in an email-mediated discussion, a
160 second stage comprising a two day symposium and a final stage involving email-
161 mediated discussions to develop and refine emergent issues from the symposium. The
162 individuals involved in this process comprised representatives of academic
163 institutions, business, voluntary organisations, statutory bodies, and the UK national
164 and local government. These people were all invited because of their established
165 record of interest in, and commitment to academic, managerial or decision making
166 roles relating to the urban environment. Furthermore, the group was drawn from
167 across Europe and it was selected to be representative of different academic
168 disciplines (e.g. psychology, and design, sociology, planning, ecology, and health).

169

170 The email-mediated discussion amongst the group was facilitated by a chair person
171 (Philip James) who ensured that all emails were shared amongst the whole group and
172 periodically produced a compendium of emails covering specific time periods. In this
173 way all contributors were made aware of the ongoing debates and the chronology and
174 provenance of the ideas. These email exchanges began the process of developing a
175 sophisticated picture of the scope and concerns related to the topic. Thereafter
176 participants were invited to submit key research questions developed from the
177 previous email-mediated discussions. In total 215 questions were submitted.

178

179 The second stage was the two day symposium. All forty participants in the email-
180 mediated discussions were invited to the symposium and twenty nine were attended.

181 The symposium was based on facilitated group discussions with participants being

split into three multidisciplinary teams, each one having representatives from all the disciplines represented at the symposium. Each team then had one session discussing research areas and emergent research themes, and three sessions refining the research questions. Following the symposium further email-mediated discussion took place to consolidate the emergent, integrated framework and to finalise the catalogue of research questions.

Emergent Research Agenda: *Five Research Themes and Thirty-five Research Questions*

The pre-symposium email-discussions enabled the original catalogue of 215 questions to be categorised into five emergent themes: the physicality, the experience, the valuation, the management, and the governance of urban green space. Further refinements during the symposium and post-symposium email-mediated discussions reduced these to 50 questions and finally to 35 questions. This catalogue of questions in conjunction with the integrated framework, which is discussed later in this paper and presented in Fig. 1 form the proposed research agenda for urban green space. The questions are discussed below under the headings of the five emergent themes.

Theme 1: The Physicality of Urban Green Space

The physicality of urban green space covers ecological, microclimate, soil, air and water quality functions (i.e. provisioning and regulating services; Breuste et al., 1998; Marzluff et al., 2001; Berkowitz et al., 2003). Several physical factors differ greatly between urban and rural environments and the location, structure, composition and spatial configuration of urban green spaces will influence their ecological qualities

and functions (Pauleit and Duhme, 2000; Whitford et al., 2001; Turner et al., 2005), and thus inform the degree to which urban green space can maintain species diversity and natural processes in cities. These ecological functions may include population dynamics, community interactions and resilience, species migration, or plant pollination.

The ecosystem services provided by urban green spaces are related to the physical aspects of these spaces (de Groot et al., 2002) and are central to maintaining human health and viable wildlife populations (Tzoulas et al., 2007). Within the context of climate change urban green spaces can play a central role in both climate proofing cities and in reducing the impacts of cities on climate (Gill et al., 2007). While the role of green areas in sequestering carbon is small compared to carbon dioxide emissions produced in cities (Nowak, 1994; McPherson, 1998), urban green spaces may reduce energy consumption and thus also carbon dioxide emissions by reducing the need for air conditioning in the summer and the need for heating in the winter (McPherson, 1994; Jo and McPherson, 2001). Within the theme of *The Physicality of Urban Green Space* seven key research questions (1-7) are identified:

1. What are the ecosystem services provided by urban green spaces and how can these services be quantified?
2. What benefits does the creation of urban green space provide in areas that have poor environmental conditions or social problems?
3. What, in relation to urban form, are the required quantity, quality and configuration of urban green spaces to maintain, sustain and enhance ecosystem services and ecological function compatible with other functions?

4. What are the direct and indirect effects of the climate changes predicted in current scenarios on urban green spaces and how do these changes impact on people's well being (quality of life) in urban areas?
5. How resilient are current green space designs (including street trees) to climate change and how can resilience be improved?
6. How can urban green spaces that are robust to harsh urban environments (e.g. lack of water and sunshine) be designed and managed to mitigate the effects of climate change in urban areas and allow cities to adapt to these changes?
7. How can the provision and management of freshwater quantity and quality be promoted through urban green spaces?

Theme 2: The Experience of Urban Green Space

Urban green spaces are important in cities due to the opportunities they provide to people to come in contact with nature and with each other. Contact with nature has psychological benefits by reducing stress (Ulrich, 1984; Ulrich et al., 1991), restoring attention (Kaplan and Kaplan, 1989), reducing criminal and anti-social behaviour (Kuo and Sullivan, 2001) and by positively affecting self-regulation and restorative experiences (Korpela et al., 2001; Hartig et al., 2003; van den Berg et al., 2007; Korpela and Ylén, 2007). In addition to psychological benefits from contact with nature, there are direct physical health benefits (Pretty et al., 2006), such as addressing issues associated with obesity (Department of Health, 2004), increased longevity (Takano et al., 2002) and self reported health (de Vries et al., 2003; Maas et al., 2006). In terms of social well being urban green space contribute encourage social interaction and bring people together, reduces negative social behaviours such as aggression and violence, contributes to a sense of place and plays an important role in

fostering social cohesion and identify (Newton, 2007). These psychological, physical and social health effects of urban green spaces make them an important component of public health provision (Henwood, 2003; Newton, 2007).

However, green spaces that are perceived to be unmanaged may have a negative effect on the wellbeing of people by increasing anxiety caused by crime and fear of crime (Bixler and Floyd, 1997; Kuo et al., 1998; Jorgensen et al., 2007). The occurrence of wild animals, for example large mammals such as fox (*Vulpes vulpes*), badger (*Meles meles*), wild boar (*Sus scrofa*) and bear (*Ursus arctos*), bring with them a need to address the changing relationships between people and these animals. Urban and peri-urban ecological changes can affect the geographical range of diseases such as Lyme disease (Patz and Norris, 2004) and West Nile Virus (Zielinski-Gutierrez and Hayden, 2006). Hence, further research will show whether it is possible to quantify environmental influences and subsequent positive or negative health outcomes from different types and configurations of urban green spaces.

The aesthetic contributions of urban green spaces to city life are equally important. There is a plethora of theories and studies showing the preference amongst urban dwellers for urban areas with green spaces in them (Wilson, 1993; Appleton, 1996; Stamps, 2004; Staats and Hartig, 2004; Regan and Horn, 2005; Hartig and Staats, 2006). The character of urban green spaces has been, and continues to be, important in expressing contemporary values, beliefs and cultural trends in urban societies (Thompson, 2004).

Closely linked with aesthetic and public health aspects of urban green spaces are the cultural backgrounds of the communities that use them (Ward Thompson, 1996; Tzoulas, 2006). Different cultures have different value systems and relationships with nature. So, the role of urban green spaces in improving local quality, identity and character may be different amongst different cultural groups within the same city and also amongst individuals. Understanding how different cultural and sub-cultural groups in cities use urban green spaces is central in developing appropriate management systems (Johnston and Shimada, 2003). Hence, within the theme of *The Experience of Urban Green Space* nine key research questions (8-16) are identified:

8. How can urban green spaces be designed and managed to help meet national and regional biodiversity targets and provide access to experience nature for the urban population?
9. What are the personal and social influences that result in greater use of urban green spaces?
10. What are the dynamic interactions between societal, personality, situational, and temporal factors and individual and group engagement with urban green spaces?
11. How do the cumulative effects of cognitive, emotional, psychological and physical health benefits from multisensory contact with green spaces influence individual and community health and wellbeing?
12. What aspects and types of urban green space stimulate positive and negative physical and psychological health effects?
13. What are the necessary quantities, qualities and configuration of urban green spaces which contribute to their regular use such that different segments of a society with changing socio-demographic characteristics may gain benefits?

14. How can actual and perceived levels of crime and anti-social behaviour be managed through manipulation of landscape design in green spaces whilst maintaining ecological, landscape and aesthetic benefits?

15. How does green space affect anti-social behaviour and community development generally?

16. How can urban green spaces be used for greater benefit in environmental education and in education more generally?

Theme 3: The Valuation of Urban Green Space

In her review of English language literature on the link between quality of life and economic competitiveness of city regions Donald (2001) focused on the links between a city region's economic competitiveness and, with regards to environmental quality, concluded there was evidence suggesting a relationship between environmental quality, high technology and the attraction of knowledge workers. As the knowledge society continues to become an ever more dominant feature of the 21st century so does the importance of creating places where people wish to live and work. Luttik (2000), reporting on a study of 3,000 house transactions in the Netherlands, found that a view on a park or water leads to an increase in house prices. The observation, based on the willingness to pay concept, clearly indicates the value attributed to nearby green space by individuals. At a policy level the importance of urban green space to economic development is increasingly recognised (Benedict and McMahon, 2006; Li et al., 2005; Konijnendijk, 2003; Benedict and McMahon, 2002; Sandström, 2002; Ahern, 1995). However, at a local authority level this is may not always appear to be the case (Barber, 2007; Britt and Johnston, 2008).

The contribution made by urban green space to ecosystem services and to psychological, social and health experiences is difficult to value (Tzoulas et al., 2007; de Groot et al., 2002; Takano et al., 2002; Kaplan and Kaplan 1989; Ulrich, 1984) and there is still a need for quantitative economic evaluation of the ecosystem services/ benefits and costs (both physical and social) provided by green spaces (McPherson, 1998; Tyrväinen, 2001; Lambert, 2007; Neilan, 2008). Traditional valuation concepts (e.g. Cost Benefit Analysis, willingness to pay etc.) may not be able to cope with valuing the functions of urban green spaces that are required to strengthen their role in the decision making process within local communities and new valuation techniques may be required. Hence, within the theme *The Valuation of Urban Green Space* four key research questions (17-20) are identified.

17. What global competitive gains are delivered to cities through the provision of high quality green spaces and how can these gains be sustained / increased through green space planning and management?

18. How can transdisciplinary considerations be integrated into the development of widely accepted methodologies for quantifying and valuing ecosystem services that are provided by urban green spaces?

19. How can the multiple “public good” and “market” benefits of urban green spaces be valued and built into governance and funding decision support tools?

20. How can ecosystem services be given an appropriate valuation so that they can be considered more equitably alongside other urban system functions?

Theme 4: The Management of Urban Green Space

354 The management of urban green space including planning, design and resource
355 management requires the collaborative working of many disciplines, at different
356 spatial scales. There is variability in the mechanisms and structures governing green
357 space management and maintenance within the same country but even more so across
358 Europe (Werquin et al., 2005). Overall responsibility for urban green space rarely
359 rests with national ministries, departments or agencies concerned with city planning
360 or the environment (Carmona et al., n.d.); more usually urban green spaces are the
361 remit of municipal or regional authorities (Niemelä, 1999).

362

363 Various schemes have been proposed and implemented to differing degrees across
364 Europe including the urban forest (Konijnendijk, 2000), greenbelt and green heart
365 (Kuhn, 2003), green fingers or wedges (Jim and Chen, 2003), greenways (Walmsley,
366 2006), green infrastructure (Sandström, 2002), ecological frameworks (Kazmierczak
367 and James 2008) and ecological networks (Opdam et al., 2006; Sandström et al.,
368 2006). These and other open space planning models have been recently reviewed by
369 Maruani and Amit-Cohen (2007) who organised the various models into a
370 comparative classification framework. They found that no one model was universally
371 applicable to all functions and needs and that the different models reflect different
372 planning constructs/ concepts of the spatial or functional configuration of urban green
373 spaces. This variability in the mechanisms of governance of green spaces, conceptual
374 spatial models, and concerned agencies creates a difficulty in comparative analysis
375 and importantly in the comprehensive assessment and planning of green spaces at a
376 transnational, national or regional level. Hence, within the theme *The Management of*
377 *Urban Green Space* seven key research questions (21-27) are identified:

21. What are appropriate indicators and typologies for the comparative assessment, monitoring and prediction of the state and trends of urban green spaces and their ecosystem services across Europe?
22. What are the mechanisms by which green space can be successfully planned, designed and managed at local, regional and national levels, and how can different levels effectively work together?
23. How effective is the current theoretical basis of urban and restoration ecology in supporting sustainable urban ecosystem management strategies, and informing urban planning?
24. How can the resilience and adaptability of urban areas to future economic, housing and environmental demands be enhanced through appropriate design and management of urban green spaces?
25. How will changing social values and behaviours guide the provision and maintenance of urban green spaces?
26. How can the views and experience of all local residents inform the planning and design process of urban green spaces?
27. How can the skills base required for delivering integrated planning, design, management and maintenance of urban green spaces in supporting urban sustainability be improved?

Theme 5: The Governance of Urban Green Space

Governance is the process of making decisions that define expectations, grant authority and verify performance. Green space governance and management is commonly a local authority responsibility, often divided amongst different departments and geographical areas (Britt and Johnston, 2008; Carmona et al., n.d.).

However, it has been recognised that the way that green space governance and management responsibilities are coordinated is more important than their distribution amongst different departments. Important issues in the coordination of responsibilities of urban green space management and governance may include limitations on existing statutory and non-statutory powers, availability of skills and effective communication amongst departments (Carmona et al., n.d.). Hence, within the theme *The Governance of Urban Green Space* eight key research questions (28-35) are identified:

28. How do differing governance and management systems of urban green space influence the planning for delivery of sustainable ecosystem services and ecological function of urban green spaces?
29. What are the consequences of changing patterns of urban green space ownership?
30. What are the social and governance implications of different funding and tenure models for the delivery of high quality urban green space in which the local community is engaged fully?
31. What are the critical factors that affect the extent to which local communities are empowered to participate in local decision making processes?
32. How is the power relationship between local authorities, developers and local communities changing as communities are encouraged to become more involved in the decision making process about development and adaptation of their neighbourhood green spaces?
33. How can financial commitments of developers be reconciled with the time requirements of inclusive public consultation?

34. Which models of governance effectively facilitate meaningful participation in decision making in an environment where ownership of land parcels changes over time?

35. What is the evidence that urban green spaces have risen up the local political agenda and what difference has it made to green space resources and quality of stewardship?

An Integrated Framework for Multidisciplinary and Interdisciplinary Research on Urban Green Space

The questions identified under the previous five themes were distilled from the Delphi process described previously and, underpinned by the existing urban green space evidence base, has enabled the development of an integrated contextual framework for interdisciplinary and multidisciplinary research (Fig. 1). Such a framework aids interdisciplinary and multidisciplinary understandings, and the communication of the complexity of the issues identified during discussions. This framework, along with the detailed questions catalogued above, forms the basis of an agreed research agenda.

FIGURE 1 HERE

Ecosystem services are primarily, but not exclusively, concerned with the environmental functions provided by urban green space (Whitford et al., 2001; de Groot et al., 2002; Tratalos et al., 2007). Such environmental functions may include the provisioning of resources (e.g. food or fuel), the regulating of microclimates, the supporting of bio-geophysical process and cycles (e.g. soil formation); and cultural

interpretations (e.g. aesthetic, recreational or educational facilities) (Millennium Ecosystem Assessment, 2005). The broad socio-economic drivers of change focus on demographic, economic or socio-political factors, all of which affect urban green space. In addition to the broader socio-economic and environmental factors, there are specific pressures on urban green space, such as adapting to technological and societal changes, attracting inward investment and retaining employment, as well as promoting nature conservation and health. Social systems and processes integrate wider socio-economic and environmental factors with the management and use of urban green space. They also address issues relating to the integration of professional, academic and voluntary sector practices regarding decision making, participatory and inclusive management of urban green space. The goals of urban green space provision is concerned with improvements in the quality of life in urban areas and the quality of urban green space.

These broad areas (ecosystem services, drivers of change and, pressures on urban green space) are interrelated and this is indicated by the dotted arrows between them (Fig. 1). So, ecosystem services and the drivers of change for urban green spaces are closely interrelated, and they are expressed as identified pressures on urban green space. These varied pressures on urban green space are further addressed by social systems and processes, which are closely related with the goals of urban green space provision.

Five research themes: physicality, experience, valuation, and management of, and governance of urban green space, emerged from the Delphi process, and have been presented in this paper. The relationship between the emergent themes and research

questions with other parts of the integrating framework is indicated by the solid two way arrows in Figure 1.

Discussion

An important aspect of the integrated framework developed during this research and presented in Fig. 1 is that changes in the urban environment, as elsewhere, are the result of the complex interactions of natural and spontaneous processes as well as of the planned actions by humans (Wood and Handley, 2001; Antrop, 1998). Thus, an understanding of the detail of, and interactions between, the five broad research areas is important. Furthermore, this integrated framework demonstrates explicitly that the outcomes from different research themes of urban green space are inextricably linked and include physical and social systems and processes. What emerges from this contextual conceptualisation is that an interdisciplinary, multidisciplinary and transdisciplinary understanding of the emergent research themes are required. The proposed research agenda (Fig. 1 and the thirty five questions) facilitates the development of such studies in two ways. First, Fig. 1 identifies broad interrelationships between research areas and thus gives an indication of the potential for collaboration between disciplines. Second, the thirty five questions provide an initial catalogue of identified questions that require further research. This catalogue of questions is not definitive, nor is it prioritised, and the questions may vary in different geographical locations and at different historical times. However, it does provide a common framework for researching current urban green space topics in Europe.

Our analysis shows that whilst the general functions and benefits of green spaces are reasonably well understood, when looking to the future there is insufficient understanding of:

a) How to plan, design and manage green sapce (how large, how to connect, etc.); and

b) How green spaces will behave under socio-demographic and environmental change.

In looking towards an international research agenda the framework (Fig. 1), and the research questions presented here, should be seen as a tool for developing working practices that transcend disciplinary boundaries in order to develop new insights and understanding of urban green spaces: it has been designed to be resilient in order to accommodate changes in knowledge.

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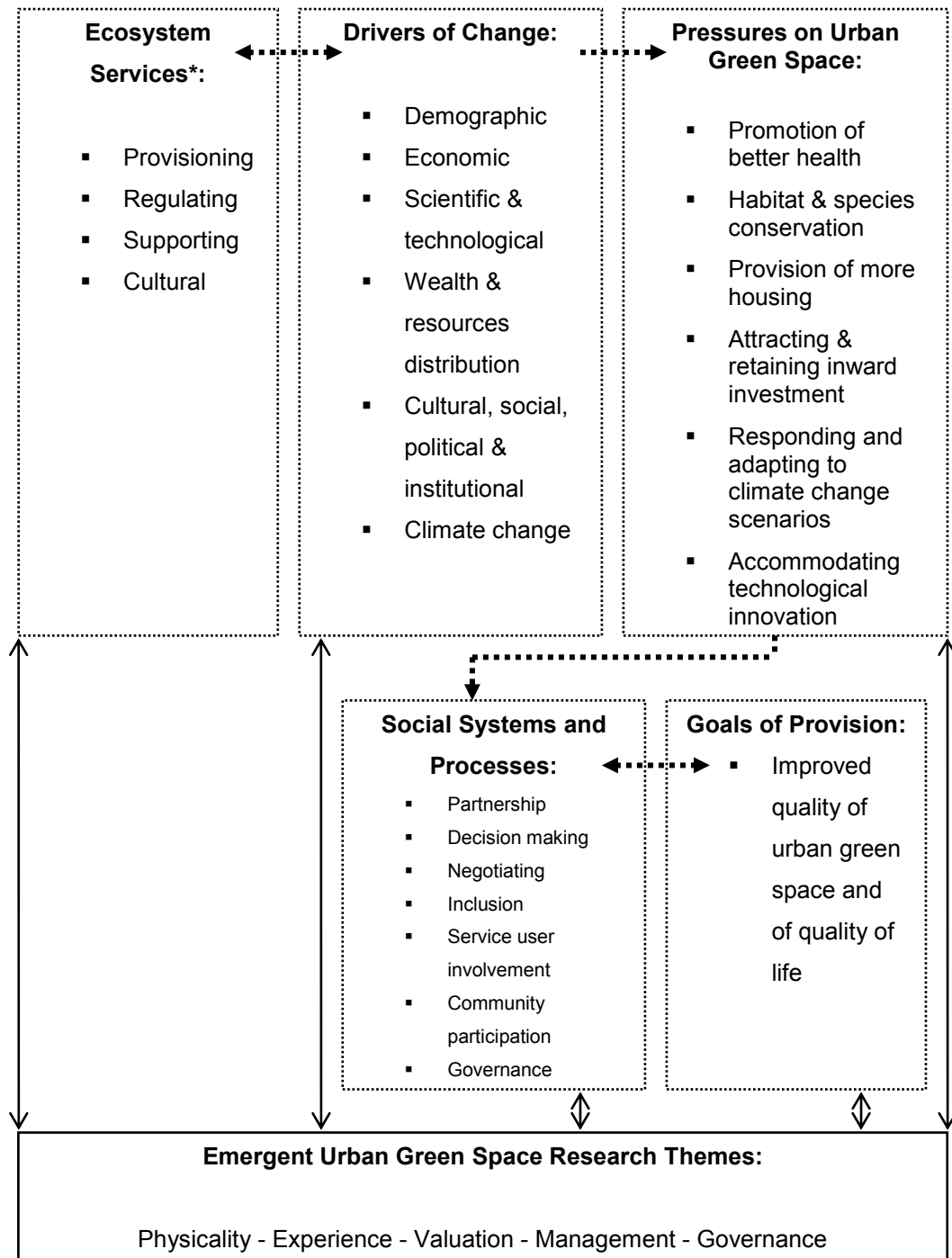


Figure 1: Integrating framework for a research agenda for urban green space

Key: Dashed boxes indicate broad research areas that are changing over time and across geographical areas; Solid box indicates specific research themes that remain constant in time and geographical areas; Dashed two way arrows indicate dynamic

744 relationships between different research areas; Dashed one way arrows indicate
745 integration by the research area at which the arrows are pointing; Solid two way
746 arrows indicate that research themes are drawn from, and are applicable to, the
747 different research areas. (*) Source: Millennium Assessment, (2005).